A Summary of Microwave Remote Sensing Investigations Planned for BOREAS

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Summary

The Boreal Ecosystem - Atmosphere Study (BOREAS) is a multidisciplinary field and remote sensing study that will be implemented jointly by the United States and Canada. The goal of BOREAS is to obtain an improved understanding of the interactions between the boreal forest biome and the atmosphere in order to clarify their roles in global change. Specific objectives are to improve the understanding of the processes that govern the exchanges of water, energy, heat, carbon, and trace gases between boreal ecosystems and the atmosphere, and to develop and validate remote sensing algorithms for transferring the understanding of these processes from local to regional scales.

Two principal field sites, both within Canada, have been selected for this study. The northern site is located near Thompson, Manitoba, and the southern site encompasses Prince Albert National Park in Saskatchewan. The growing season in the northern site tends to be limited by growing-degree days while the southern site is limited by soil moisture and fire frequency. Most of the field work will occur at these two sites during 1993 and 1994 as part of six field campaigns. The first of these campaigns is scheduled for August 1993 and will involve instrument installation and an operational shakedown. Three large scale Intensive Field Campaigns (IFCs) are scheduled for 1994, along with two smaller scale Focused Field Campaigns (FFCs). The first 1994 campaign will be an FFC designed to capture the biome under completely frozen conditions during the winter. The second FFC and the first IFC are scheduled to capture the spring thaw period. Another IFC will take place in the summer during a period of maximum water stress. Finally, the third FFC will be scheduled to capture the collapse into senescence during the fall.

The BOREAS science team has been organized into six disciplines, one of which centers on remote sensing science investigations. The five microwave investigations have been included in this group. These activities consist of four radar studies and one passive microwave investigation. Titles of these studies are listed below together with the principal investigators and a brief statement of their primary objectives:

(1) Microwave scatterometer observations of boreal forest species.
M. C. Dobson, The University of Michigan

Objective: Obtain c- and x-band scatterometer measurements of 2-3 tree species within the two test sites. Backscatter from each species will be observed for 4-5 days continuously during each of the three IFCs. These measurements will then be used to verify linkages between biophysical controls and SAR observations.

(2) Distribution and structure of biomass in boreal forest ecosystems.
K. J. Ranson, NASA Goddard Space Flight Center
R. H. Lang, George Washington University

Objective: Determine the amount and spatial distribution of above-ground biomass. The planned activity includes development of algorithms for determining the amount standing biomass and its apportionment from SAR backscatter, development of model inversion techniques, and determination of the optimum radar parameters for use in estimating canopy biomass.

(3) Estimation of hydrological parameters in boreal forest using SAR.
S. Saatchi, Jet Propulsion Laboratory, California Institute of Technology

Objective: Estimate hydrologic parameters of the forest and underlying ground surface. The water content of the vegetation and ground surface and surface cover will be examined with SAR. Hydrologic parameters of soil, snow, moss and permafrost will be studied.

(4) Monitoring environmental and phenologic state and duration of state with SAR as input to improved CO_2 flux models.
J. B. Way, Jet Propulsion Laboratory, California Institute of Technology
K. C. McDonald, Jet Propulsion Laboratory, California Institute of Technology

Objective: Classify boreal forest by functional group and determine the environmental and phenologic state and water status within each functional group. In so doing, SAR will be used to determine the photosynthetically active period of these functional groups. This information will be provided as new input for estimating the CO_2 flux of the biome.

(5) The diurnal and annual radiobrightness of boreal forest.
A. W. England, The University of Michigan

Objective: Monitor and model diurnal and seasonal radiobrightness signature of boreal forest. This information will be used to update existing cold region radiobrightness models to account for seasonal and diurnal signatures of the boreal forest.

These studies have been designed to investigate both the static and temporally varying microwave signatures of the boreal forest biome. Multifrequency polarimetric SAR imagery will be collected by aircraft-borne systems during the field campaigns. This will allow detailed analysis of the static and temporally varying aspects of backscatter. During the intervals between these campaigns, imagery from the ERS-1 satellite will provide more of a continuous monitoring capability.

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